Analysis and Design for Mobile Applications: A User Experience Approach

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Abstract. Mobile applications development has brought the new opportunities for businesses to market their brands and products through a new channel. Such a channel encourages an increasing number of users engaging in mobile applications. However, the challenge of designing "useful" mobile applications still remains. To date, only few studies have been done on the identification of user experience features on mobile applications design. To this end, this study aims to provide a systematic review of mobile applications analysis and design, exploring main design features from a user experience perspective. Three design dimensions, namely usability, functionality and aesthetic design have been focused on in the study. The results imply that current mobile applications design needs to be further improved to meet users' experience. The major contribution is to propose a systematic analysis of mobile applications for business managers and designers.

Keywords: Mobile applications · User experience approach · Aesthetic design

1 Introduction

With the rapid development in mobile and wireless technologies, an increasing number of users engage in mobile applications (apps). Users are now able to customize their mobile platforms with applications that suit their needs [1]. This trend, not only changes and impacts on the way of users' living and thinking, but also brings huge opportunities to business to define their mobile marketing. Mobile applications have generated intensive interest within business due to the high user engagement and the positive image that a brand transfers through applications [2]. It has been proved that the use of mobile applications has a positive persuasive impact increasing interest in the brand. In contrast to other forms of advertisements, mobile applications are welcomed as "useful," which suggests that they may be one of the most powerful forms of advertising yet developed [3]. Mobile applications design varies from business to business in terms of strategies, goals and feature designs etc. The qualities of mobile applications also differ significantly from one to one. How can these businesses get on the right track of designing their mobile applications? Some studies have been conducted in brand experiences, which are not related to mobile applications; some have been carried out on user satisfaction of mobile applications in specific domains, such as government and location based service. However, to date, no research has been done

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on the identification of the framework and user experience features which can be of use to businesses developing their mobile applications.

To this end, this research aims to provide a systematic review of mobile applications analysis and design, identifying main constructs and features in mobile applications design from a user experience perspective. To be more specific, three dimensions in the user experience design, namely usability, functionality and aesthetic design have been addressed in order to develop more user-centered mobile applications. Our main contribution is to propose a systematic analysis of mobile applications for business managers and designers. The different criteria (usability features, functional features, aesthetic features) proposed in this research can be used as a guidance in the development of mobile applications.

This paper is structured as follows. In Sect. 2 we provide some background on user experience design, and discuss usability, functionality and aesthetic design in mobile applications. In Sect. 3 we present our research method and develop associated evaluation criteria. We then detail our data analysis and discussion in Sect. 4. Finally, our conclusion, implications and limitations are detailed in Sect. 5.

2 User Experience Design

User experience (UX), a buzz word in the field of Human-Computer Interaction (HCI), can be understood as a consequence of a user's internal state, the characteristics of the designed system and the context within which the interaction occurs [4]. User experience is crucial for the product designers to enhance user satisfaction and foster user interaction [5]. In this study, a number of features necessary for designing effective mobile applications are reviewed and categorized mainly from the field of HCI. Tables 1, 2 and 3 present relevant dimensions of UX design and their detailed design features from the literature review. Three main dimensions are focused on: functionality, usability, and Aesthetic design. Each dimension has its detailed design features.

Table 1. Usability dimension

UX design dimension	Design feature	Description	Refs
Usability	Navigation	To clearly show current position To clearly show exit button To support cancellation and redo To make process design meet users' needs	[5, 9, 12]
	Learnability	To support user learning capability To explain and guide for complex interaction	[13]
	Standard and consistency	To present information in consistent and standardized form To keep consistent color scheme	[14]
	User language	To use user understandable language To use short and direct language	[15]

Usability is one of most important design dimension for mobile application design [6]. According to the ISO [7], usability refers to the effectiveness, efficiency and satisfaction with the extent to which a mobile application can be used by the specific users to achieve specific goals in the specific context of use. Since mobile application usability differs from mobile device usability, the former has been importantly addressed for mobile application interface design, which is related to how ease of use and user-friendliness. Ease of use refers to the degree to which users perceive that using the particular system can achieve their performance [8]. User-friendliness is about the perception of aesthetic design in terms of mobile application interface [9]. Many studies use multiple features to explain mobile application usability design. For example, Zhang and Adipat [10] explain that mobile application usability should be learnability, efficiency, memorability, error, satisfaction effectiveness, comprehensibility and learning performance. Helander and Khalid [11] describe usability dimension in aspects of simplicity; support; accessibility; visibility; reversible action; feedback and personalization. In their explanation, simplicity refers to using simply functions; support is about maintaining user in control; accessibility and visibility may be implied by making objects accessible and visible; reversible action is to provide undo functions at all times; feedback is to provide visible comment mechanism after services, and personalization is related to allow user to customize interface.

Functionality is a critical factor in mobile application design because it is about the quality of mobile application being functional [16]. Functionality commonly refers to a set of functions and properties that satisfy users' requirements in the completion of their tasks, and contains a number of sub design elements including navigation, Accuracy [17], Suitability [14] and security [18]. Navigation refers to ability to guide user movement; accuracy is the ability to provide the right results with the required degree

Table 2. Functionality dimension

UX design dimension	Design feature	Description	Refs
Functionality	Search function	To provide search function To build indexes of data	[16]
	Response time	To offer accurate feedback To provide timely feedback for user action	[20]
	Control	To use user familiar controls To place aside the controls which may result serious consequences To reuse same controls over pages To show accurate control status To use clear and effective text on controls To allow user to control flow, reduce use of the system mandatory	[17, 21–23]
	Data preservation	To make function work without errors To minimize error occurrence	[18]
	Content relevance	To offer relevant information or content	[14]

of precision; suitability refers to the ability to have the adequate functions for the required tasks; and security is to prevent unauthorized access to services or data. Indeed, mobile applications are composed of functional (e.g., search function, tracking function) or non-functional (e.g., information presentation, information structure) components. Both functions and services constitute the basis for user interaction [19]. With a higher level of functionality, users can better use mobile applications, which can lead to a greater performance in interacting with information and services [6].

Aesthetics design has a long historic tradition in the research literature, and has been considered as a core property of mobile application design. It has been the subject of discussions by researches, such as beautiful objects incorporate proportion, harmony, and unity [15], and designers for example universal elements of beauty are order, symmetry, and definiteness [24]. Huang and Benyoucef [25] argue that aesthetics design provides the first impression of information systems. Users usually judge an aesthetics quickly because before other cognitive processes take place, preconscious judgements based on visual design elements are already made. The issues of aesthetics were raised by Wells et al. [9] whose aim is to discover the relationships between different design dimensions and perceived attractiveness through systematic manipulations of visual stimuli. Such relationship is further explored by Hoehle and Venkatesh [6], who claim that aesthetics design closely relates to user performance, level of usage and perceived quality of information systems. For example, by designing more aesthetic and identifiable icons, users can search for information and services more efficiently [9]. Moreover, providing rich visual graphics can increase overall quality of mobile applications, which in turn may attract user attention and support their task completion [6]. Accordingly, aesthetics design in mobile applications should be emphasized on a number of sub design features, including text, color, format, icon and multimedia.

Table 3. Aesthetic dimension

UX design dimension	Design feature	Description	Refs
Aesthetic design	Text	To make a layered text arrangement To improve readability To use list appropriately	[9, 13]
	Color	To make color scheme meet product features and characteristics of the target user groups To use limited color	[26]
	Format	To make proper spacing To distinct layers To use proper font size To use line spacing, alignment, indentation	[9, 27]
	Logo	To make logo appearance in each main page	[19]
	Icon	To make icons easy to understand To indicate clear, accurate information To make icons matched the overall style	[23, 24]
	Multimedia	To use meaningful multimedia effects To make multimedia style matched overall style To use animation properly	[28, 29]

3 Research Method

In order to better understand the design for mobile applications in this study, a heuristic evaluation was used on 45 branded applications developed by top 11 Fast Moving Consumer Goods (FMCG) brands. We believe it is a sector close to daily consumers.

In order to conduct the evaluation, we have developed the evaluation criteria of each dimension of user experience design (see example in Table 4). The criteria are adapted and refined from the literature review presented in the previous section.

Table 4. Evaluation criteria development

UX design dimension	Design features	Evaluation criteria
Usability	Navigation	App indicates current position App shows exit button at all times App provides cancellation and redo at any time
	Learnability	App reduces user memory load App offer clear user action feedback App provides guidance for complex interaction
	Language	App uses short and clear user language App employs understandable language
	Standard and consistency	App keep content expression consistent and standardized App uses consistent color scheme
Functionality	Search function	App makes search function available App allows users to search information in their own way
	Structure	App provides clear content structure App makes function shortcut available App places key content in a easy read location
	Control	App allows user control flow, reduce use of the system mandatory App process design meets needs of users task execution App place the controls in logical order App uses user familiar controls App reuses same controls over pages App provides clear text on controls App shows accurate control status
	Response time	App delivers timely feedback to users App provides accurate feedback
Aesthetic design	Text	App arranges text in a hierarchical way App ensures images corresponding to the context App uses list appropriately
	Color	App uses proper color scheme to meet user needs App utilizes limited color
	Format	App offers proper spacing App uses distinct layers App uses use proper font size App uses line spacing, alignment, indentation
	Logo	App makes icons easy to understand App provides logo on each page App makes icons style matched the overall style
	Multimedia	App uses appropriate and meaningful multimedia effects App makes multimedia style matched the overall style

Two coders conducted the content of branded applications. The coding categories were reviewed and discussed by both coders. Each item was coded with 0 and 1, while 1 is implied that the app has achieved the design criteria. Unclear items were clarified during the coding procedure. 45 branded applications were coded together and non-disagreement was found among the coders.

4 Results and Discussion

Understanding mobile applications design in terms of usability and the factors affecting user experience is crucial for the mobile applications designers to enhance customer satisfaction. Our results found a number of weak user experienced design features in selected 45 mobile applications. Among them, the weak design features that have been commonly found on the target mobile applications include "key information being not placed in a central location on the page", "inconsistent display format on each page" and "the absence of search functionality" (Fig. 1).

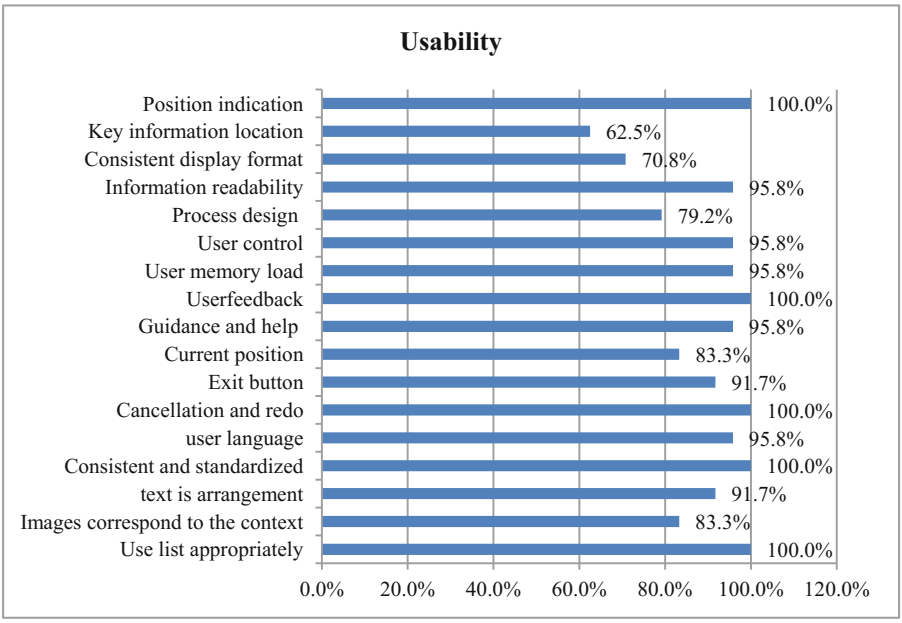

Fig. 1. Usability results

To be specific, central location is a focal point where it is used to emphasize the key element of a page. Since information or subject is presented in such a location, it makes the information or subject stand out and controls the users' gaze, drawing attention to the main area of the page. However, failure of presenting information in an easy read location may impact mobile applications content readability, which may take users more time to get important information (Fig. 2).

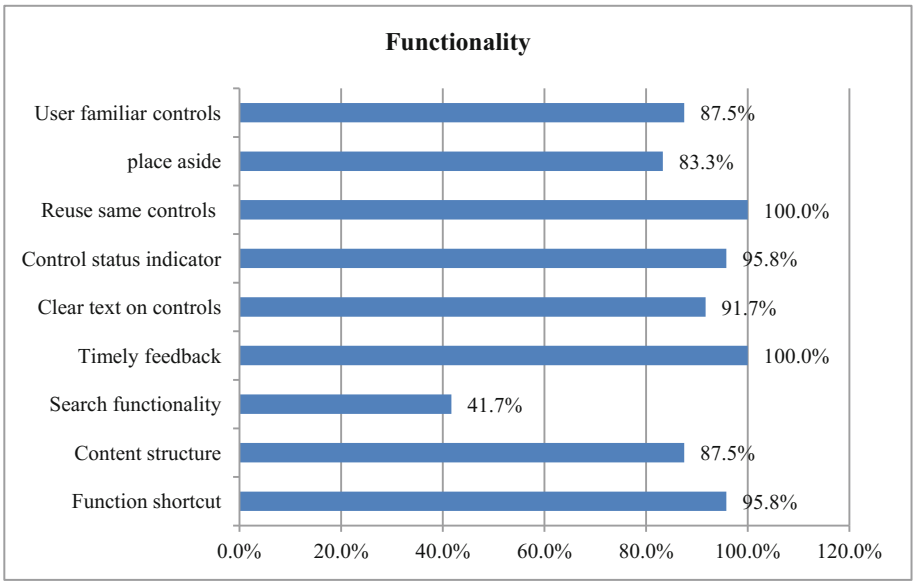

Fig. 2. Functionality results

Display format consistency is used to establish unity across pages of mobile applications, strengthening visual subject recognition and reducing layout clutter. It helps users understand that information visually provided is organized and presented in

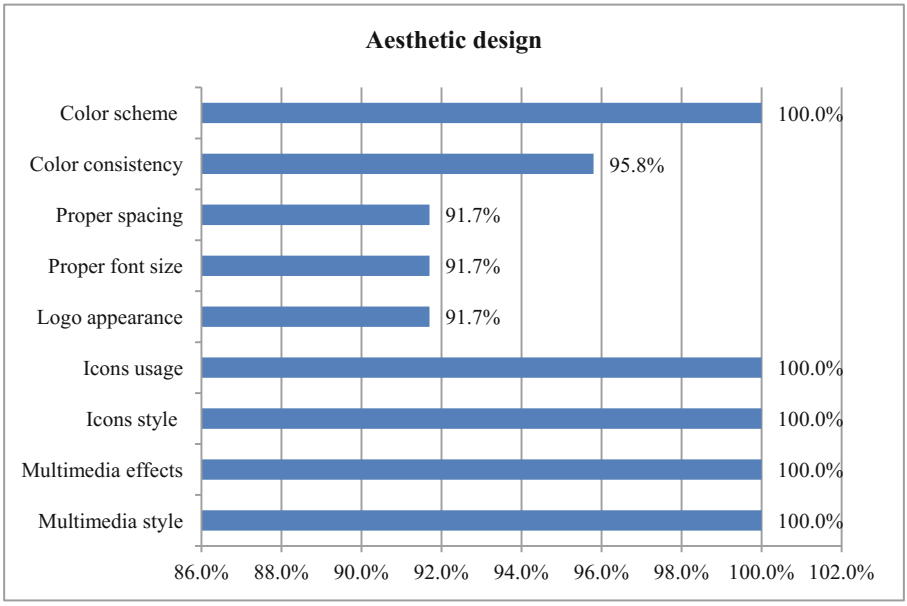

Fig. 3. Aesthetic design results

the same way throughout the applications. As such, after the initial experience with the mobile applications, consistent display format enables users to easily locate information to meet their needs. As indicated by Agarwal and Venkatesh [13], consistent display form an important part of overall design consistency, which may lead to better user performance and lower error rates. Conversely, failure of information presentation with consistent format may affect visual continuity of the mobile applications, which may cause users difficulties in searching information (Fig. 3).

Another weak user experience design feature is the absence of search function. The search engine is used to retrieve information. A high search capability can generate precise, comprehensive and relevant search results, which can help users easily locate the target object. Conversely, the lack of search engine or search engine with weak searching capability may influence the search effectiveness, so that users may feel it is difficult to find useful information to meet their search requirements.

5 Conclusion

Mobile applications development has brought challenges and opportunities for businesses to market their brands and products through a new channel. Traditional companies shall move towards this new culture facing together evolving technologies, changing user behaviors, and new marketing paradigm and strategies. To overcome these challenges, this study conducts a user experience approach to analyze mobile applications design, especially focusing on usability, functionality and aesthetic design dimensions. The results found a set of common weak design features on the target mobile applications, include "key information being not placed in a central location on the page", "inconsistent display format on each page" and "the absence of search functionality". Moreover, the particular design issues have been also identified on the mobile applications. It suggests that current mobile applications need to improve their design quality to meet the users' needs, supporting them to achieve their desirable outcomes. The major contribution is to propose a systematic analysis of mobile applications for business managers and designers. The different criteria (i.e. usability features, functional features, aesthetic features) proposed in this research can be used as a guidance in the development of mobile applications.

However, these are some limitations in this study. First, this study only addresses a user perspective, which may provide a limited viewpoint from the business side. Further study may consider the mobile applications design in aspects of brand goals and business strategies. Second, two coders are invited to conduct the content of branded applications, which may limit our results. More participants may be involved in order to provide more comprehensive results.

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